Development of Inter-industrial Metal Network with Input-Output based Material Flow Analysis

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Metals have strongly contributed to the development of the human society. Today, large amounts and various metals are utilized in a wide variety of products. Metals are rarely used individually but mostly together with other metals in the form of alloys and/or other combinational uses. While combinational uses of metals provide a lot of useful properties for materials, they tend to make recycling of end of life metal scrap more complicated to be separately recovered. For sustainable use of metals resources, current circumstance of metal uses and their combination should be well understood and quantified.
This study reveals the inter-sectoral flow of metals by means of input-output (IO) based material flow analysis (MFA). Using the 2007 United States IO table, we calculate the flows of eight metals (i.e., manganese, chromium, nickel, molybdenum, niobium, vanadium, tungsten and cobalt) and simultaneously visualize them as a network. We quantify the interrelationship of metals by means of flow path sharing. Furthermore, by looking at the flows of alloys into metal networks, the networks of the major metals iron, aluminum, and copper together with those of the eight alloying metals can be categorized into alloyed-, non-alloyed-(i.e. individual), and both mixed.
The result shows that most metals are used primarily in alloy form and that functional recycling thereby requires identification, separation, and alloy-specific reprocessing if the physical properties of the alloys are to be retained for subsequent use. The quantified interrelation of metals helps us consider better metal uses and develop a sustainable cycle of metals.